margin within the test and a definite and clear line of suture separates them from the interradial edges. The pairs of pores are remote from the interradio-ambulacral suture and there is not a vestige of a "process."

The interradial swelling sometimes rises to a blunt, raised edge separated by a little space from the peristomial margin. This blunt part is doubtless a degenerated "ridge," and it does not appear capable of affording origin or insertion to muscular structure.

It appears that *Echinoconus* is much lower in the scale of Echinoidea with regard to perignathic structure than the species of *Discoidea*, and certainly these are degraded below those of *Holectypus*, which have a feeble yet fairly perfect girdle, jaws, and teeth.

XXVIII.—*On* Atherstonia, *a new Genus of Palæoniscid Fishes from the Karoo Formation of South Africa; and on a Tooth of* Ceratodus *from the Stormberg Beds of the Orange Free State.* By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History).

[Plate XIV.]

The only remains of Palæoniscid fishes from the Early Mesozoic Karoo Series of South Africa hitherto described or figured are some detached scales made known by Egerton * under the names of *Palæoniscus Bainii* and *P. sculptus*. However, through the generosity of the Hon. W. Guybon Atherstone, M.D., F.G.S., of Grahamstown, the British Museum is now in possession of a nearly complete fish from the Beaufort Beds of Colesberg; and it is the object of the present notice to describe and discuss the principal characters of this fossil, illustrated in the accompanying Plate XIV. figs. 1–3.

Description.

The specimen is shown, nearly one half nat. size, in Pl. XIV. fig. 1, and a flank-scale of the natural size in fig. 2, while a few scales at the base of the dorsal fin form the subject of fig. 3. The general form of the fish is well indicated; but the head is much crushed and its precise contour probably destroyed, while the extremity of the caudal fin has been

* Sir P. Egerton, "Note on the Fish-remains from Styl Krantz, South Africa," Trans. Geol. Soc. [2] vol. vii. (1856), pp. 226, 227, pl. xxviii. figs. 26–42.

removed by an unfortunate line of joint in the rock. The trunk is elongate-fusiform, the head and opercular apparatus occupying about one fifth of the entire length; and the maximum depth of the trunk before crushing would also bear a similar proportion to the length. The upper lobe of the tail is extremely produced and slender. The mandibular suspensorium is very oblique and the head and opercular bones are externally ornamented with tubercles and rugæ; but no details can be observed of the cranial osteology.

Appendicular Skeleton.—The fins are all tolerably well preserved except the caudal, which, as already remarked, is partly broken away. They all consist of broad, laterally compressed, and closely arranged rays, frequently articulated, and with distal bifurcation; and, most probably, judging from a small specimen mentioned below, there is a series of minute fulcra upon the anterior margin of the preaxial ray. In the pectoral fins at least eight or nine rays are unarticulated in the proximal half of their length; but all seem to be closely jointed distally and are also perhaps bifurcated. The pelvic fins are remarkable for the length of their base-line; each consisted probably of about eighteen or twenty rays, gradually decreasing in length posteriorly, and all are distinctly articulated quite from their point of insertion. The dorsal fin arises behind the posterior extremity of the pelvic pair, and the anal fin is so remote that even its first rays scarcely oppose the hinder portion of the dorsal. Each of these median fins is longer than high, the anal being especially elongated and consisting of not less than forty-five or fifty rays, of which the seventh or eighth is the largest and followed by gradually shortening rays posteriorly.

Squamation.—The trunk is completely invested in a covering of thick rhomboidal scales, united by peg-and-socket joints, except towards the extremity of the tail, and externally ornamented with delicate branching ridges, though with a smooth posterior edge. There is considerable variation in the size and proportions of the scales in different parts, those in the middle of the flank of the abdominal region being largest and those at the base of the insertion of the fins the smallest. The middle flank-scales (fig. 2) are deeper than broad, with a very prominent peg-and-socket articulation; and the usual internal rib appears to be only developed in those situated more posteriorly and upon the caudal region. Ventrally—and also dorsally in the caudal region—the scales become rapidly broader than deep, until the breadth is often twice as great as the depth. At the base of the dorsal and anal fins there is also a singular diminution of the size of the

scales, apparently by the division of each vertical series into two, as suggested by appearances at the base of the dorsal (fig. 3); and it is probable that a similar arrangement occurs in connexion with the pelvic fins. Upon the sides of the extremely attenuated caudal lobe the scales exhibit the usual elongation of one diagonal; but the proportions of the large fulcral ridge-scales cannot be observed, owing to the imperfection of the fossil. The most remarkable feature in the squamation, however, is the enormous development of the ridge-scales along the entire extent of the dorsal margin. The series commences immediately at the back of the head and comprises sixteen or seventeen scales as far as the dorsal fin; and though there is a diminution in size behind the dorsal, they still maintain relatively large proportions. Each of these scales is saddle-shaped, being very slightly arched from side to side; there is considerable overlapping, and the external surface is ornamented with fine ridges, mainly disposed in an antero-posterior direction.

Determination.

The family relationships of the fish thus described are so obvious as to require no detailed discussion, and its generic affinities are likewise readily determinable. In the appearance of the scales, the situation and proportions of the fins, and the recognizable features of the head, this South-African fish most nearly approaches *Gyrolepis* *, from the European Trias and Rhætic, and *Rhabdolepis* †, from the European Lower Permian. That it is, however, generically distinct is indicated by the enormous development of the dorsal series of ridge-scales; and as it seems appropriate to employ the name of the discoverer of the first tolerably complete specimen, the genus may be briefly defined as follows:—

Atherstonia.

Trunk robust; mandibular suspensorium very oblique and gape wide. [Teeth unknown.] Fins powerful, with minute fulcra; pelvic fins with an elongated base-line, the dorsal arising between the pelvics and the anal, and the last-named fin remote, much elongated. Scales relatively large, externally marked with coarse oblique striæ and subdivided into smaller scales at the base of the dorsal, anal, and pelvic fins;

* W. Dames, "Die Ganoiden des deutschen Muschelkalks," Palæont. Abhandl. vol. iv. (1888), pp. 135–137.

† R. H. Traquair, "On the Agassizian Genera *Amblypterus*, *Palæoniscus*, *Gyrolepis*, and *Pygopterus*," Quart. Journ. Geol. Soc. vol. xxxiii. (1877), p. 552.

dorsal margin with a continuous series of very large deeply overlapping ridge-scales.

The single known species described above may be termed *Atherstonia scutata*.

Stratigraphical Position and associated Fish-Fauna.

Dr. Atherstone's fossil was obtained from the Beaufort Beds of Colesberg, Cape Colony, and the imperfectly preserved trunk of a smaller fish of the same genus from a corresponding horizon at Alice, near Fort Beaufort, was long ago recorded by Owen *, without description, under the MS. name of *Hypterus Bainii*. The latter fossil is also exhibited in the British Museum (No. 46007), having been presented by the Trustees of the Albany Museum; and it may even be specifically identical with *Atherstonia scutata*, though further specimens are required for satisfactory discussion. The British-Museum collection, moreover, contains fragments of other Palæoniscid fishes from various parts of the great Karoo Series of South Africa, though, like the scales described by Egerton, these cannot as yet be precisely determined; and the only associated fishes of other types hitherto definitely known are *Semionotus capensis* and *Cleithrolepis Extoni* from the Stormberg Beds †, in addition to the tooth of *Ceratodus* described below.

In conclusion, through the kindness of Professor Rupert Jones, F.R.S., the writer is enabled to append a synopsis of the subdivisions of the South-African "Karoo Series" of A. G. Bain, showing the stratigraphical position of the few fossil fishes from that formation already described:—

KAROO SERIES (*A. G. Bain*).

- Stormberg Beds (Upper Karoo). Yield *Palæoniscus Bainii*, Eg., *P. sculptus*, Eg., *Semionotus capensis*, A. S. Woodw., *Cleithrolepis Extoni*, A. S. Woodw., and *Ceratodus capensis*, A. S. Woodw.
- Beaufort Beds (Lower Karoo). ["Karoo Beds" of Green, Quart. Journ. Geol. Soc. 1888, and "Upper Karoo Beds" of Dunn's Map and Report.] Yield *Atherstonia scutata*, A. S. Woodw.
- Kimberley Shales. ["Olive Shales" of Stow, Quart. Journ. Geol. Soc. 1874.]
- Ecca Beds. [Including "Koonap Beds" and "Ecca Beds" of T. Rupert Jones, Quart. Journ. Geol. Soc. 1867, the "Lower Karoo Beds" and "Dwyka Conglomerate" of Dunn's Map and Report.]

* R. Owen, 'Catalogue of the Fossil Reptilia of South Africa' (1876), p. ix.

† Smith Woodward, "On two new Lepidotoid Ganoids from the Early Mesozoic Deposits of Orange Free State, South Africa," Quart. Journ. Geol. Soc. vol. xliv. (1888), pp. 138–143, pl. vi.

Note on a Tooth of Ceratodus *from the Stormberg Beds of the Orange Free State, South Africa.*

Though not hitherto recorded, the occurrence of *Ceratodus* in the Karoo Series of South Africa is a circumstance to be expected, and it is interesting now to be able to make known the discovery of a very typical tooth. The specimen in question was received by the British Museum in exchange from the Bloemfontein Museum, Orange Free State, through the intervention of Dr. Hugh Exton, F.G.S., and the locality being Smithfield, Orange Free State, the fossil was doubtless obtained from the fish-bearing horizon of the Stormberg Beds. The tooth is unfortunately imperfect, as shown in the accompanying figure (Pl. XIV. fig. 4); but sufficient remains to render its approximate determination possible. It is of comparatively small size, thin, and triangular in shape, with the angulation of the inner margin acute and placed opposite the second denticle. When complete the denticles would be at least five in number, and these are all separated by deep notches at the outer margin, while the ridges extending from them are acute and some nearly reach the inner angulation.

In the acuteness and number of the ridges the new South-African tooth most nearly approaches those of *Ceratodus serratus*, Ag.*, *C. Philippsii*, Ag.†, *C. runcinatus*, Plien.‡, and certain forms discovered in the Kota-Maleri Beds of India §. From all these, however, the specimen differs in being as thin as the rounded-ridged teeth of *C. Kaupi*, Ag.; and it may therefore be regarded as indicating a new species —*Ceratodus capensis*.

EXPLANATION OF PLATE XIV.

Fig. 1. *Atherstonia scutata*, gen. et sp. nov. Lateral aspect of fish, one half nat. size.—Beaufort Beds, Colesberg, Cape Colony. [Brit. Mus. No. P. 4735.]

Fig. 2. The same. Flank-scale; *a*, external aspect; *b*, internal aspect, twice nat. size.

Fig. 3. The same. Scales at base of dorsal fin, nat. size.

Fig. 4. *Ceratodus capensis*, sp. nov. Tooth; *a*, coronal aspect; *b*, anterior aspect of the same.—Stormberg Beds, Smithfield, Orange Free State. [Brit. Mus. No. P. 4807.]

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* L. Agassiz, Rech. Poiss. Foss. vol. iii. (1838), p. 135, pl. xix. fig. 18.

† L. Agassiz, *ibid.* p. 135, pl. xix. fig. 17.

‡ Meyer and Plieninger, Beitr. Paläont. Württembergs (1844), p. 86, pl. xi. fig. 8.

§ T. Oldham, "On some Fossil Fish-Teeth of the Genus *Ceratodus* from Malédi, South of Nagpur," Mem. Geol. Surv. India, vol. i. (1859), pp. 295–309, pls. xiv.–xvi.